HYDROGEN PEROXIDE

by

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History

Hydrogen peroxide is manufactured for commercial use as a comparatively weak solution in water, *e.g.* 35% by weight H_2O_2. Its use as a bleaching agent is widespread in textile and other industries. The solution sold as a disinfectant and mild bleaching agent at the chemist's shop is a very dilute solution, usually 3%.

The manufacture and use of concentrated hydrogen peroxide solutions, *i.e.* stronger than 60%, has a short history. First used in Austria during the first World War as one constituent of a blasting explosive mixture, little work was carried out with the substance until the early 1930's when Doctor Pietsch of Elektrochemische Werke, Munich and H. Walter, later of Walter Werke, Kiel, became interested in its possibilities for weapon propulsion. The large scale use of concentrated hydrogen peroxide by the Germans in the war was largely due to the early efforts of these two men.

German cover-names for the substance included T-Stoff (Trieb-Stoff), Ingolin, and Aurol. The British commercial name for these strong solutions is High Test Peroxide (HTP). German HTP was in two main grades, designated TS and TSS. The latter was very highly stabilised for filling torpedoes.

Properties of HTP

Unlike water (H_2O), which is an extremely stable compound of hydrogen and oxygen, H_2O_2 is easily decomposed thus :—

$$2\ H_2O_2\ \text{(liquid)} \rightarrow 2\ H_2O\ \text{(liquid)} + O_2\ \text{(gas)} + \text{heat.}$$

The heat released is considerable, *i.e.* 1,242 B.Th.U/lb., and large volumes of superheated steam and oxygen are made available. The usefulness and possible danger of H_2O_2 are both due to these two properties.

From H_2O_2 solutions, the heat and oxygen releases are naturally less than from 100% H_2O_2. The properties of 80% solution (HTP (80)) are :—

Gross heat release	995 B.Th.U./lb.
Oxygen release	38% (weight)
Specific gravity	1·35
Freezing point	2°F.
Boiling point	266°F.
Viscosity	appreciably greater than water.
Coefficient of expansion ...	about nine times that of water.
General properties	A colourless liquid with a powerful oxidising action. Is easily decomposed by heat or by catalytic action. Iron, steel, rust and many common substances are catalytic. Pure aluminium, stainless steel, glass and certain plastics are non-catalytic.

HTP is soluble in water in all proportions. Water is the most effective extinguishing agent for fires started by HTP leaks. HTP spilt on the human flesh is not dangerous provided it is washed off immediately with water. The area affected will probably be bleached white and suffer slight irritation.

Stability of HTP

Stabilised HTP in the higher concentrations is very stable provided it is kept at normal temperatures and free from catalytic material. The decomposition loss when stored under correct conditions is of the order of 1% per year. In unsuitable tanks, or if catalytic material is allowed to enter the liquid, the HTP will decompose more rapidly. The decomposition reaction is exothermic and the liquid will thus be heated up. This rise in temperature itself speeds up the decomposition ; every 20°F. rise in temperature doubles the decomposition rate. Provided the surrounding conditions are such that the heat escapes from the container at the same rate as it is generated, a stable temperature will be reached in the range 120°-280°F., depending on conditions.

If this temperature is exceeded, however, the reaction will accelerate and may get out of control. If the HTP is not confined, it will then " boil off." If it is confined, however, it will eventually burst the container, the degree of violence depending on the degree of confinement. At its worst the explosion will be extremely violent.

Pure HTP up to 85% concentration cannot be detonated by shock. This does not apply to HTP mixed with more than a certain minimum amount of combustible material.

Manufacture

HTP (100%) is not made outside the laboratory. 90% is about the limit at present for large scale production, 85% being more common.

The main German plant in operation during the war employed an electrolytic process known as the " persulphate " method. Other methods were under consideration and the world's patent literature is extensive on the subject.

HTP is always manufactured at from 20-40% concentration and then concentrated in separate plant by fractional distillation. Different stabilisers are added by different manufacturers and in proportions depending on the projected use of the product.

Application for Propulsion

HTP may be used most simply as an energy source, a driving gas of superheated steam and oxygen being employed in a rocket motor or in a turbine, or other expansion engine. It was used thus, as a mono-propellant, in the original experimental Walter U-boat (V.80), in certain Walter rocket-assisted take-off units for aircraft, for the fuel pump turbine of the A.4 long range rocket missile (V.2), in the V.1 launching gear, and in one or two other minor weapons.

HTP is more efficiently used, however, as both an energy and an oxygen source, a fuel being burned in the oxygen/steam atmosphere to obtain a much greater heat release per lb. of total propellants.

It was used thus, as one component of a two-fluid propellant system, in the Walter U-boat engines, Walter torpedo engines and " hot " rocket motors such as the HWK 409-109 for Me.163.

It must be emphasised that the success of any of these German applications depended on solution of the problems raised by producing and handling HTP.